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Applicant : Mohammed IMBABI

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Filed : Concurrently Herewith (I.A. Filed January 13, 2003)

For : AIR PERMEABLE CLADDING PANEL

CLAIM OF PRIORITY

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant hereby claims the right of priority granted pursuant to 35 U.S.C. 119 based upon British Application No. 0200610.4, filed January 11, 2002. The International Bureau already should have sent a certified copy of the British application to the United Stated designated office. If the certified copy has not arrived, please contact the undersigned.

Respectfully submitted,
Mohammed IMBABI

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PRIORITY DOCUMENT

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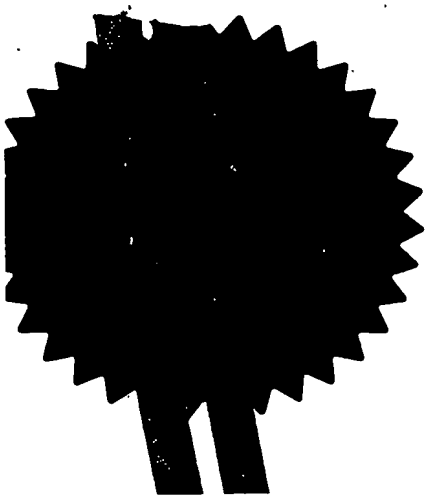

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1/77

14JAN02 E687299-2 D02732
P01/7700 0.00-0200610.4

Request for grant of a patent

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The Patent Office

Cardiff Road
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1. Your reference — A1406

2. Patent application number — 0200610.4 — 11 JAN 2002

3. Full name and postcode of the or of each applicant *(underline all surnames)*

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Patents ADP number *(if you know it)* 2939510005

If the applicant is a corporate body, give the country/state of its incorporation — UNITED KINGDOM

4. Title of the invention — CLADDING

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

ABLETT & STEBBING
CAPARO HOUSE
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LONDON
W1U 6FQ

Patents ADP number *(if you know it)* 6551001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
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YES

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Priority documents	0
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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	0
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11. I/We request the grant of a patent on the basis of this application.

Signature [signature] Date

ABLETT & STEBBING 11 January 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

G K ABLETT / S J SUÈR (0207-935-7720)

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CLADDING

The present invention relates to cladding and in particular, but not exclusively, to such cladding when applied to buildings located in relatively polluted areas.

In this regard, airborne particulate and gaseous pollution is known to have a hugely detrimental effect on human health. In conventional buildings, much emphasis is placed on achieving airtightness and low infiltration losses, with controlled fresh air intake ducted into the building using a mechanical *Heating, Ventilation and Air Conditioning* (HVAC) system. Floor and wall apertures are traditionally specified in Codes of Practice to provide trickle ventilation, with opening size specified on the basis of floor area. Thermal insulation in such buildings passively curtails conduction heat loss, to improve energy efficiency. This outlines the tried-and-tested approach, and though it continues to be technically valid, its drawbacks are high capital and maintenance costs and tight minimum ventilation quotas to limit heating energy demand. In some cases, illnesses known as 'Sick Building Syndrome' have been attributed to inherent design shortcomings, poor implementation or lax maintenance of the HVAC installation itself.

The current UK Government has declared its commitment to reduce the concentration of airborne particulate matter (Review of Air Quality Strategy, 2001). Significant research has been carried out in recent years to understand the effect of particulate matter on human health (Seaton *et al*, 1995; COMEAP, 1998). Nonetheless, uncertainty still exists. The potential effects are substantial enough, however, for the UK Government to recommend that the precautionary approach be applied to the issue of particulate emissions. This asserts that the potential risk should be reduced to as low as is reasonably practicable even though there is much that is still not understood.

Efforts to derive a strategy to minimise particulate emissions have been problematical. Much of the problem is due to the source and location of source of particulate matter.

In this regard, the source of particulate air pollution in cities is principally derived from:

1. Primary particles – from the products of incomplete combustion (mainly road traffic, electricity production, building space heating)
2. Secondary particles – formed in the atmosphere from the chemical reaction of sulphurous and nitrous emissions.
3. Biological particles – re-suspended road dust, construction, quarrying, sea salt, agricultural.

Each source is responsible for roughly a third of the total of urban background concentration. In the UK, typically 80% of emissions originate from UK sources but this percentage can fall if certain wind conditions exist. Anti-cyclone wind conditions can cause this figure to fall to 50% (or lower in the SE of England). Current strategies to limit particulate emissions concentrate on *front of pipe solutions*, mitigating or eliminating emissions from diesel engines and power plants for instance.

However, due to the diverse nature and location of the sources of particulate matter, the original limits set in initial World Health Organisation guidelines in 1997 were rejected as unattainable. These initial World Health Organisation guidelines could not have been met, for instance, even if the utopian situation of no road traffic were to be achieved. The limits were thus increased.

It is clear, therefore, that an alternative strategy is required to deal with removal of particulate matter from the atmosphere.

In this respect some work has been undertaken by the inventors of the present application in providing a "breathable" wall cladding for buildings, whereby the building is provided with panels which are permeable to air and which include a single insulating layer. Air flows through the panels, driven by a differential in pressure between the interior and exterior of the building. Air that flows into the building picks up heat that is being conducted outwards. The insulation provides filtration characteristics such that particulates can be trapped by the insulation as they pass through the cladding. However, the inventors have identified problems in relation to clogging of the insulation which reduce the effectiveness of the "breathable" wall cladding concept.

An object of the present invention is to alleviate the problems identified above.

According to a first aspect of the present invention there is provided a cladding material comprising:- an outer air permeable cover; an inner air permeable cover; and an intermediate layer, wherein the intermediate layer is provided with a graduated filtering profile.

The development of a graduated filtering profile has been found to enable selective particle filtration, to enhance filtration through depth within the intermediate layer and hence delay clogging. This thereby avoids the existence of predominantly surface filtration and rapid filter-cake deposition that can lead to premature clogging.

Preferably, the filtering characteristics of the intermediary layer are such as to trap relatively large particles(>10 μm) towards the outer cover end of the intermediary layer and to trap relatively smaller particles (0.01 μm) towards the inner cover end of the intermediary layer.

In preferred embodiments, the cladding material has other features including thermal and/or sound insulating properties.

Conveniently, the intermediate layer comprises one or more of:- mineral wool, wet-blown cellulose and glass wool.

Preferably, the intermediate layer is provided in the form of one or more of:- membranes, fibres, pulp or cellular based (foam or sponge) materials or other such materials which are cost effective and readily available.

The cladding material may comprise materials possessing filtration properties specific for one or more of:- particulate emissions, gas pollutants, chemical agents and biological agents.

In preferred embodiments, the cladding material is provided in the form of panel units. Conveniently, the panel units are provided in modular format. Implemented in a modular format, walls can be fabricated from such panel units comprising layers of different materials with complementary particulate filtration

characteristics, one or more of which could additionally enable filtration of gaseous pollutants, chemical and/or biological agents, etc. The adoption of a modular approach is important, since the panels can ultimately be produced in a variety of shapes, sizes and finishes to meet the demands of a diverse construction market, optimised for either new-build or retrofitting, and mass produced to keep costs low and availability high.

Preferably, the intermediate layer is formed of a plurality of separate air permeable filter layers, of different filtering characteristics. The intermediate layer may alternatively be formed of a single filter layer, whose filtering characteristics vary across its thickness. The or each filter layer of the intermediate layer may be independently replaceable, whereby a clogged filter layer can be removed and replaced or reconditioned when required.

In preferred embodiments, the or each filter layer of the intermediate layer may comprise one or more disposable filter elements. If clogged, such filter elements can be removed, for example by "peeling off" and safely disposed of to expose a fresh filter surface. The lifespan of the panel can be prolonged in this manner.

In preferred embodiments where a plurality of filter layers are present, each filter layer of the intermediate layer is selected to extract a specified range of particle sizes. Conveniently, the separate filter layers of the intermediate layer together define substantially the complete spectrum of particulate and other pollution.

In preferred embodiments, the cladding material is for a building.

According to a second aspect of the present invention there is provided a cladding system for cladding a building at a particular location, comprising the steps of:-

a) identifying the nature of pollutants at that location;

b) establishing an appropriate filter configuration for that building at that location;

c) forming cladding panel units for the building, the panel units having a graduated filtering profile across their thickness according to the filter configuration; and

d) applying the panel units to the building.

The present invention further encompasses a building comprising a plurality of panels formed of cladding material as defined above and a building cladding layer for use in the cladding material as defined above, the cladding layer having a graduated filter profile.

According to a third aspect of the present invention there is provided a building cladding panel comprising an air-permeable material, the material further being configured to filter out harmful chemical and/or biological agents.

According to a fourth aspect of the present invention there is provided a system for improving air quality in a particular location, the system comprising the steps of:-

a) placing at that location a building adopting air permeable cladding material; the cladding material comprising a filtration layer for removing one or more of:- particulate emissions, gas pollutants, chemical agents and biological agents as air passes from the exterior of the building to its interior; and

b) arranging for filtered air from within the building to pass to the exterior of the building.

The present invention hence provides for a pollution removing dynamically insulated, air permeable cladding material. When applied to a building, fresh ventilation air can be heated and filtered as it is drawn into the building through a durable, purpose-designed porous building envelope. A new type of 'breathing wall' cladding panel is hereby provided enabling urban environments to be developed that are less polluted and healthier to live in, and contributing positively to sustainable future development.

Dynamic insulation permits the movement of air through a permeable,

dynamically insulated wall. This reduces conduction heat loss and provides a method of bringing fresh air into the building. The materials needed to achieve this (i.e., possessing appropriate insulation and permeability characteristics) are available, and include conventional insulation materials such as mineral wool, wet-blown cellulose and glass wool. A well designed dynamically insulated building can dispense with large heating and ventilation plant and ancillaries (ducting, etc.), allow higher controlled ventilation rates to be achieved, and reduce fossil fuel consumption by cutting out conduction heat loss. They effectively enable any desired building fabric heat loss coefficient, or U-value, to be achieved using thinner than conventional walls in a range of building types, including multi-storey buildings, easily surpassing current UK and European Building Standards and Regulations.

An embodiment of the present invention will now be described by way of example with reference to the drawing in which:-

Figure 1 shows schematically a cross-section taken through a section of cladding according to the invention.

As shown in the example of Figure 1, the invention concerns a multi-layer cladding panel 1 of modular construction, comprising a series arrangement of air permeable intermediate or internal layers 2 of varying properties and thickness contained within an optional vented outdoor-facing weatherproof cover 3 and an optional indoor-facing wearing surface cover 4.

The internal layers may be bonded directly to the outer and inner covers, or separated by one or more air plenums, depending on design/fabrication requirements. In operation, fresh ventilation air is drawn into the building through such cladding panels forming all or part of the envelope (skin) of the building, and stale air is exhausted from the building through an outlet duct to atmosphere (not shown). Used over a sufficiently large area of the building envelope, the panels will provide heat and sound insulation characteristics that surpass existing regulations and standards. More importantly, as air is slowly drawn into the building through the panels, the different internal layers will each extract a fraction of the overall particulate content and other forms of

pollution from the air flow in a manner commensurate with their individual filtration characteristics. Such characteristics may include porosity, permeability, packing density, fibre size (in the case of fibrous insulation), as well as chemical properties, biological properties, etc.

This gradation of complementary filtration properties of the intermediate or internal layer 2 may be provided by using separate filtration layers as shown, or by use of a single contiguous layer of air permeable insulation. The cumulative effect of this combination of insulation layers or gradation of properties is permanent removal of substantially all pollution from the air being used to ventilate the building, and in time cleaning of the outdoor environment itself.

The multi-layer construction or graduated single layer construction and the selection of the filter characteristics of the layers facilitates filtration through the depth of the cladding panel, which correctly implemented prevents pre-mature clogging of the panel and ensures an acceptable service life before replacement or refurbishment is required. This provides a unique and innovative solution to the air pollution problem, especially in the case of particulates. Buildings using such cladding panels, in the manner described, will act to preserve the health and well-being of both building occupant and the surrounding environment as part of their normal operation, unlike the conventional buildings of today which do neither.

To function correctly in the environment of a building, the cladding material requires appropriate filtration and pressure drop properties of its component layers, good thermal and sound insulation, and resistance to environmentally induced degradation.

The internal layer or layers 2 may be formed of membranes, fibres, pulp, or cellular-based (foam or sponge) materials. The range of applications across the filtration spectrum spans the ionic (atomic radius) to the macro-particle (fine sand) ranges. Fibres present the most attractive choice for use in dynamically insulated buildings due to their efficacy in the $PM_{2.5}$ – PM_{10} range at the flow velocities of interest, wide availability, utility, low cost, and prevalence as

conventional building insulation materials.

The cladding may further comprise materials for room-temperature catalytic conversion of for example COx, NOx and Sox. Chemical and biological agent filters can also be included as part of an enhanced panel design.

The or each filtration layer of the intermediate or internal layer 2 may comprise one or more disposable filter elements. If clogged, such filter elements can be removed, for example by "peeling off", and safely disposed of to expose a fresh filter surface. The lifespan of the panel can be prolonged in this manner.

Where a plurality of filter layers are present, each filter layer of the intermediate layer can be selected to extract a specified range of particle sizes.

The present invention is not to be limited in scope by the specific embodiment described herein. Indeed, various modifications of the invention will become apparent to those skilled in the art from the foregoing description and accompanying figure. Such modifications are intended to fall within the scope of the appended claims.

Claims:-

1. A cladding material comprising:-

an outer air permeable cover;

an inner air permeable cover; and

an intermediate layer, wherein the intermediate layer is provided with a graduated filtering profile.

2. A cladding material according to claim 1, wherein the filtering characteristics of the intermediary layer are such as to trap relatively large particles towards the outer cover end of the intermediary layer and to trap relatively smaller particles towards the inner cover end of the intermediary layer.

3. A cladding material according to claim 1 or 2, wherein the intermediate layer has thermal and/or sound insulating properties.

4. A cladding material according to any preceding claim, wherein the intermediate layer comprises one or more of:- mineral wool, wet-blown cellulose and glass wool.

5. A cladding material according to any preceding claim, wherein the intermediate layer is provided in the form of one or more of:- membranes, fibres, pulp or cellular based (foam or sponge) materials.

6. A cladding material according to claim 5, wherein the intermediate layer

comprises fibres.

7. A cladding material according to any preceding claim, wherein the cladding material comprises filter materials for one or more of:- particulate emissions, gas pollutants, chemical agents and biological agents.

8. A cladding material according to any preceding claim, wherein the cladding material is provided in the form of panel units.

9. A cladding material according to claim 8, wherein the panel units are provided in modular format.

10. A cladding material according to any preceding claim, wherein the intermediate layer is formed of a plurality of separate filter layers, of different filtering characteristics.

11. A cladding material according to claim 10, wherein each filter layer of the intermediate layer is selected to extract a specified range of particle sizes.

12. A cladding material according to claim 11, wherein the separate filter layers of the intermediate layer together define substantially the complete spectrum of particulate and other pollution.

13. A cladding material according to any one of claims 1 to 9, wherein the intermediate layer is formed of a single filter layer, whose filtering characteristics vary across its thickness.

14. A cladding material according to any one of claims 10 to 13, wherein the or each filter layer of the intermediate layer is independently replaceable.

15. A cladding material according to any one of claims 10 to 13, wherein the or each filter layer of the intermediate layer comprises one or more disposable filter elements.

16. A cladding system for cladding a building at a particular location, comprising the steps of:-

a) identifying the nature of pollutants at that location;

b) establishing an appropriate filter configuration for that building at that location;

c) forming cladding panel units for the building, the panel units having a graduated filtering profile across their thickness according to the filter configuration; and

d) applying the panel units to the building.

17. A building comprising a plurality of panels formed of cladding material according to any one of claims 1 to 15.

18. A building cladding layer for use in the cladding material according to any one of claims 1 to 15 comprising a graduated filter profile.

19. A building cladding panel comprising:-

an air-permeable material, the material further being configured to filter

out harmful chemical and/or biological agents.

20. A system for improving air quality in a particular location, the system comprising the steps of:-

a) placing at that location a building adopting air permeable cladding material; the cladding material comprising a filtration layer for removing one or more of:- particulate emissions, gas pollutants, chemical agents and biological agents as air passes from the exterior of the building to its interior; and

b) arranging for filtered air from within the building to pass to the exterior of the building.

21. A system for improving air quality according to claim 20, comprising the cladding material according to any one of claims 1 to 15.

22. A cladding material substantially as hereinbefore described with reference to the accompanying Figure.

23. An air improvement system substantially as hereinbefore described with reference to the accompanying Figure.

24. A cladding system substantially as hereinbefore described with reference to the accompanying Figure.

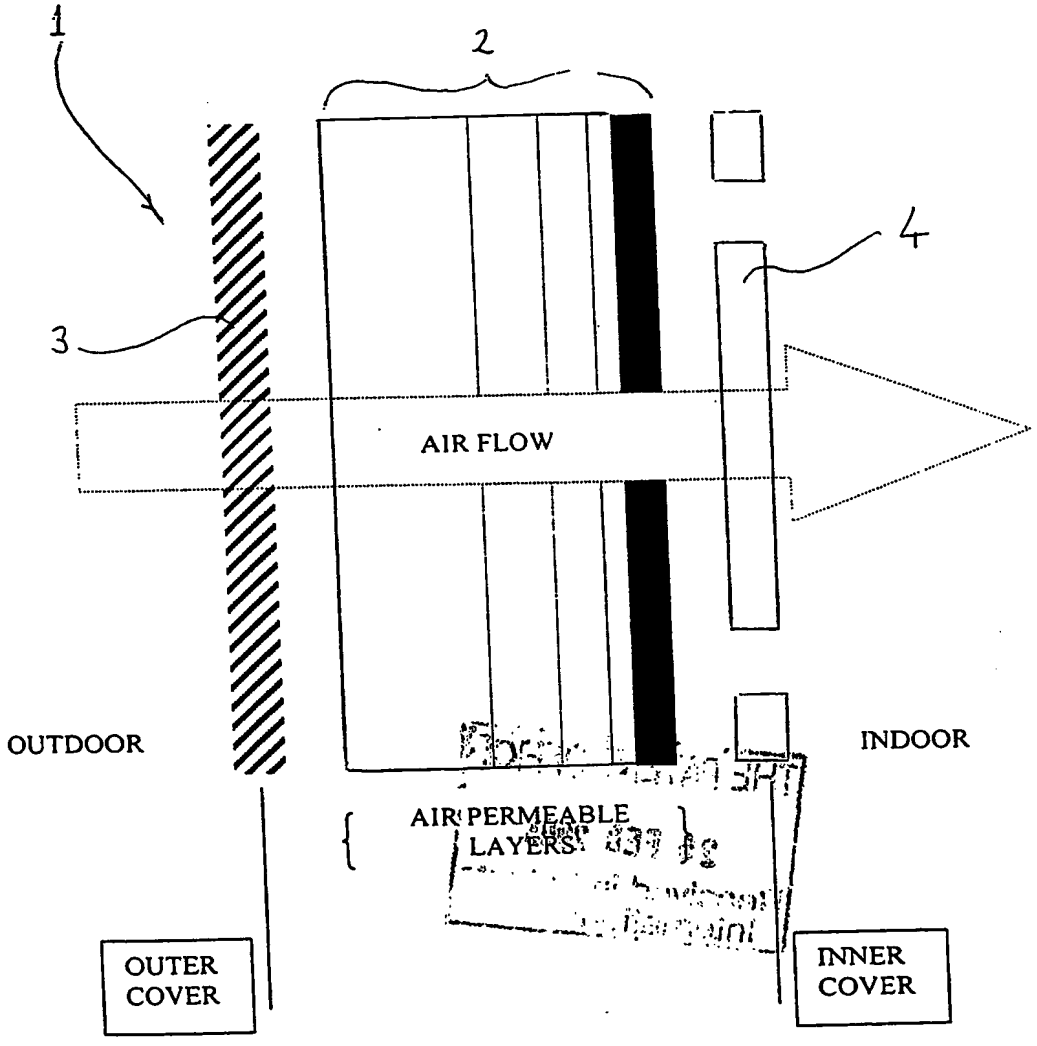
1
2
3
4
AIR FLOW
OUTDOOR
INDOOR
AIR PERMEABLE LAYERS
OUTER COVER
INNER COVER

Figure 1